Ξ (Ω) Production in Pb+Pb Collisions at 158 GeV/c

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Measurements of doubly strange baryons and antibaryons in high energy heavy ion collisions allow us to probe into the dynamics of hot and dense nuclear matter [1], [2]. In particular, heavy hyperons (Ξ, Ω) appear to be important since, due to their large mass, they are likely to be produced in the early stages of the collisions when the nuclear density is the highest, and, therefore new phenomena (e.g., phase transitions [3]), are likely to occur. This paper presents results obtained by the NA49 experiment on the production of $(\Xi + \overline{\Xi})$ at the CERN SPS based on a study of the decays of $\Xi \rightarrow \Lambda + \pi^-$ (where $\Lambda \rightarrow p + \pi^-$) and $\overline{\Xi} \rightarrow \overline{\Lambda} + \pi^+$ (where $\overline{\Lambda} \rightarrow \overline{p} + \pi^+$) from about 50,000 central Pb+Pb events. The measurements were done without magnetic field. The new method of measuring and analyzing multi-strange hyperons in the absence of a magnetic field was proposed and implemented. This method makes use of the easier/high-accuracy (straight line) tracking in the large TPC volumes in the absence of E$\otimes$B distortions. For details see [4]. A very high degree of background rejection based on a coplanarity constraint was demonstrated. This allowed us to avoid the standard statistical approach with deconvolution of signal and background peaks in the invariant-mass distribution and led to the direct rapidity and transverse momentum spactra. It provides a tremendous advantage in the very high multiplicity environment where the standard analysis suffers from low efficiency. On the physics side: 278 Ξ and $\overline{\Xi}$ (+ Ω and $\overline{\Omega}$) particles were measured in 48,119 central Pb+Pb events for $2 < y < 2.6$ and $1 < p_T < 3$ GeV/c. The ratio $(\Xi+\overline{\Xi})/(\Lambda+\overline{\Lambda})$ was estimated to be $\sim (13 \pm 4)\%$, which is consistent with the equivalent ratios measured in lighter systems (S+S, S+Pb and S+Au) - see Fig.6. If, with further analysis, the results remain unchanged, that will mean that this new and very efficient mechanism of strangeness production is independent of the volume of the interacting system and/or on the degree of equilibration. This is an astonishing result and presents a particular challenge to any hadronic kinetic model.

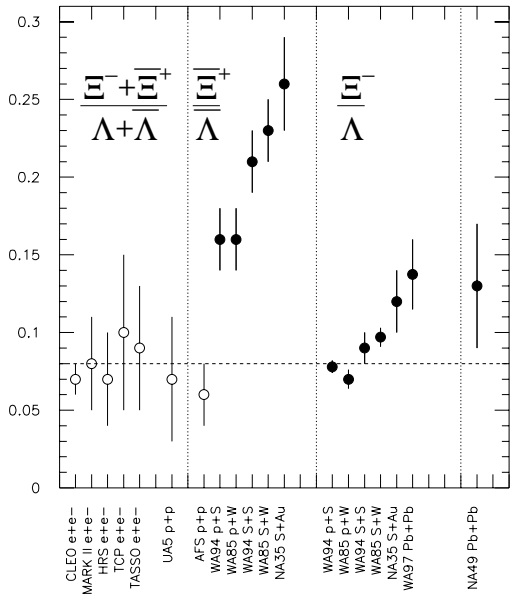

Figure 1: The Ξ/Λ and $\overline{\Xi}/\overline{\Lambda}$ ratios for different experiments at CERN SPS energies.

References

[1] J.Rafelski and B.Müller, Phys.Rev.Lett. 48 (1986) 1066, Phys.Rev.Lett. 56(1986)2334.

[2] P.Koch, B.Müller and J.Rafelski, Phys.Rep. 142(1986)167.

[3] J.Rafelski, Phys.Lett. B262(1991)333.

[4] G.Odyniec and the NA49 Coll., J.Phys. G23 (1997) 1827.